人工放射性元素表（1939末現在)

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人工放射性元素表 (1939 末現在)

放射性同位元素は現在既に原子番號85以下の總ての元素に亙つて報告されてゐる．本表は自然活性核（本誌前號，p. 98—106參照）以外の總ての人工的放射性同位元素を，その主要なる特性に關聯する事項と共に，J. J. Livingood 及 G. T. Seaborg が 1939年十二月一日迄の文獻に據て，今年の *Reviews of Modern Physics* 誌上に掲載した一覽表を再錄したものである．

必要な參考文獻は夫々アルファベットと數字との組合せ（例へば，A1, A2, B1, B2 の如し）を以て之を表はし，表中各關聯する項目の箇所に夫々附記される．各參照文獻の明細は更に取纏めて表の最後に記載される．

1. *Z*- 欄は原子番號．
2. *A*- 欄は質量數．
3. *Class*- 欄は各記載事項の確實性程度の差違を示すもので，次の省略記號に依て之が示される．即ち

   A— 同位元素確定的(質量數及元素確定的)

   B— 同位體可能的，元素確定的

   C— 數箇の同位體の內何れか一つ，元素確定的

   D— 元素確定的

   E— 元素可能的

   F— 證據不十分

   G— 多分誤謬ならん(不純物或は不適當な半減期決定等の爲めに)．
4. *Type of Radiation*- 欄には次の略號が用ひられる．即ち

   β^- — 陰 β-粒子

   β^+ — 陽 β-粒子

   γ — γ-線

   e^- — 內部變換電子

   K — *K*- 軌道電子捕獲

   I.T.— 異性核轉移（核異性の高い狀態より低い狀態への轉移）．

   γ 線放出のない事が確實な場合には，此事實を "no γ" の記號を以て第7欄に記入される．
5. *Half-Life*- 欄，半減期に數箇の數値が報告されてゐる場合には，その最良と思はれる實驗値が引用される．
6. *Energy of Radiation*- 欄にはエネルギー値と共に其出所文獻及エネルギー決定に用ひられた方法が記入される．此處に與へられる β- 粒子のエネルギーはスペクトルの上

限の觀測値に相當し，唯單に Konopinski-Uhlenbeck の外挿値のみが報告されてゐる場合には，"K. U." の記號を之に附して其數値が記載される．

(i) 粒子のエネルギー決定に用ひられた方法は次の略號に依て夫々表示される．卽ち

abs.— 吸收

cl. ch.— 磁場をもつた cloud chamber

spect.— 電子の磁氣スペクトル或はスペクトロメター．

(ii) 又 γ-線のエネルギー決定に用ひられた方法を附記する爲めに次の記號を用ふる．

abs.— 吸收

cl. ch. recoil— 磁場をもつた cloud chamber 中の二次電子

cl. ch. pair— 磁場をもつた cloud chamber 中の陰陽電子對

coincid. abs.— coincidence counters 及 absorber に依る二次電子

spect. conv.— 磁氣スペクトルグラフに依る internal conversion electrons

spect.— 磁氣スペクトログラフに依る二次電子

abs. of e^- — 內部變換電子の吸收．

內部變換電子が放出される場合には，揭出のエネルギー値は常に相當する γ 線轉移のエネルギーである．

7. "*Produced by*"-欄には夫々所定の放射性同位元素生成に就て觀測された核反應（ターゲット元素，投射粒子及生成殘餘粒子の順序に表示する）及其參考文獻が列擧される．(p=プロトン，n=ニウトロン，α=α-粒子，d=重水素イオン，γ=γ-線)

ニウトロンに依て誘導される重元素の分裂反應は U-n, Th-n, 及 Pa-n の記號に依て記入されてゐる．

Radio-element		Class	Type of Radiation	Half-life	Energy of Radiation (MeV)		Produced by	Observers
Z	A				Particles	γ-rays		
1	H^3	A	β^-	~150 d.(A7)	~0.02(A7) abs.		D-d-p(A7)	A7
2	He^6	A	β^-	0.8 s.(B1)	3.7(B1, B2) cl. ch.		Be-n-α(B1, P1, B3) (Li-n-p)(K1, N1)	B1, N1, K1, P1, B2, B3
3	Li^8	A	β^-, α	0.88 s.(L1)	12(β^-)(B4) cl. ch.		Li-d-p(C1, L1, R14, D1) B-n-α(L24), (Li-n-γ)(K1)	L1, B4, C1, D1, R14, K1, L24
4	Be^7	A	K, γ	43 d.(R1)		0.45(R1, M1) abs. Pb.	Li-d-n(R1, R13) B-p-α(R1, M1) Li-p-n(H1, H2)	R1, M1, H1, H2, R13
5	B^{12}	A	β^+	0.022 s.(C2, B22)	12(B4) cl. ch.		B-d-p(C2, F1, B5)	C2, F1, B4, B5, B22
6	C^{11}	A	β^+	21.0 m.(R11)	1.15(F1) cl. ch.		B-d-n(F1, C4, Y1) B-p-γ(C3, B23) B-p-n(B23) N-p-α(B23) C-n-2n(P2)	F1, C3, Y1, C4, P2, B23 R11
7	N^{13}	A	β^+, γ	9.93 m.(W12)	0.92, 1.20 (L22) spect.	0.28(R2) cl. ch. recoil	C-d-n(H3, Y1, C4, F1) C-p-γ(H3, C4) B-α-n(F1, R3) N-n-2n(P2)	H3, E1, Y1, R2, C4, F1, P2, B20, L22, W12
	N^{16}	A	β^+	8 s.(C5, N1)	6.0(F1) cl. ch.		N-d-p(F1) O-n-p(C5) F-n-α(N1, P1, N4)	F1, C5, P1, N1, N4
8	O^{15}	A	β^+	126 s.(M3, B20)	1.7(F1) cl. ch.		N-d-n(M3, F1) O-γ-n(B20) O-n-2n(P2) N-p-γ(D2) C-α-n(K3)	M3, F1, B20, P2, D2, K3
	O^{19}	A	β^-	31 s.(N1)			F-n-p(N1, A1)	N1, A1
9	F^{17}	A	β^+	70 s.(N2)	2.1(K4) cl. ch.		O-d-n(N2, F1) N-α-n(R3) O-p-γ(D2)	N2, K4, F1, R3, D2
	F^{18}	A	β^+	112 m.(S1)	0.7(Y2) cl. ch.		Ne-d-α(S1) O-p-n(D2) F-n-2n(P2) O-d-n or O-d-γ(Y2)	S1, D2, P2, Y2, B20
	F^{20}	A	β^-	12 s.(C1)	5.0(F1) cl. ch.		F-d-p(F1, C1) F-n-γ(N1) Na-n-α(N1)	F1, C1, N1
10	Ne^{19}	A	β^+	20.3 s.(W7)	2.20(W7) cl. ch.		F-p-n(W7)	W7
	Ne^{23}	A	β^-	40 s.(A1, B6)			Na-n-p(A1, N1, P1) Mg-n-α(A1, B6)	A1, N1, B6, P1
11	Na^{21}	A	β^+	3.0 y.(L3)	0.58(L3) cl. ch.	1.3(O2) spect.	Mg-d-α(L3) F-α-n(L3, M4) Ne-d-n(L3)	L3, M4, O2
	Na^{24}	A	β^-, γ	14.8 h. (V1)	1.4(L21) spect.	1.0, 2.0, 3.0(R4) cl. ch. recoil	Na-d-p(L4, V1) Na-n-γ(A1) Mg-n-p(A1) Al-n-α(A1) Mg-d-α(H4)	L4, A1, R4, H4, V1, L21
12	Mg^{23}	A	β^+	11.6 s.(W7)	2.82(W7) cl. ch.		Na-p-n(W7, D9)	W7, D9
	Mg^{27}	A	β^-, γ	10.2 m.(H4)	1.8(C13) cl. ch.	0.9(R4) cl. ch. recoil	Mg-d-p(H4) Mg-n-γ(A1) Al-n-p(A1)	H4, A1, R4, C13
13	Al^{24}	A	β^+	7.0 s.(W7, F2)	2.99(W7) cl. ch.		Na-α-n(M4, F2) Mg-p-n(W7, D9)	M4, F2, W7, D9
	Al^{28}	A	β^-, γ	2.4 m.(A1, M5, E2)	3.3(C6) cl. ch.	2.3(C6) cl. ch. recoil	Al-d-p(M5) Al-n-γ(A1) Si-n-p(A1) P-n-α(A1) Mg-α-p(E2, R3)	M5, C6, A1, E2, R3
	Al^{29}	A	β^-	6.7 m.(B27)	2.5(B27) cl. ch. and abs.		Mg-α-n(B27, H21, F3)	B27, H21, F3
14	Si^{27}	A		3.7 s.(K8)			Al-p-n(K8)	K8
	Si^{31}	A	β^-	170 m.(N3)	1.8(K4) cl. ch.	No γ(N3)	Si-d-p(N3) Si-n-γ(A1) P-n-p(A1, P2) S-n-α(S2, C9)	N3, K4, A1, P2, S2, C9

Radio-element		Class	Type of Radiation	Half-Life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
15	P^{30}	A	β^+	2.55 m.(R3)	3.6(A2) spect.		Al-α-n(R3, C7) Si-d-α(S2) P-n-2n(P2) P-γ-n(B20) Si-p-n(B23) Si-He^3-p(A7)	C7, R3, A2, S2, P2, B20, A7, B23
	P^{32}	A	β^-	14.30 d.(C8)	1.69(L5) spect.	No γ (K4)	P-d-p(N3) P-n-γ(A1) S-n-p(A1) Cl-n-α(A1) S-d-α(S2) Si-α-p(F3)	N3, L5, C8, A1, K4, S2, F3
16	S^{31}	F	β^+	26 m.(P2)			S-n-2n(P2)	P2
	S^{35}	A	β^-	88 d.(L6)	0.107(L6) spect.		Cl-n-p(A3, L6)	A3, L6
17	Cl^{34}	A	β^+	33 m.(S2, B21)	2.5(B21) abs.		P-α-n(F2, R3, B21) S-d-n(S2) Cl-n-2n(P2) Cl-γ-n(B20)	F2, R3, S2, P2, B20, B21
	Cl^{36}	A	β^+, K, β^-	>1 y.(G9)	0.7(β^-)(G9) abs.		Cl-n-γ(G9) Cl-d-p(G9)	G9
	Cl^{38}	B	β^-, γ	37 m.(VI)	4.8(K4) cl. ch.	2.0, 2.5(R7) cl. ch. recoil	Cl-d-p(K4, VI) Cl-n-γ(A1) K-n-α(H5)	K4, R7, VI, H5, A1
18	A^{35}	G	β^-	4 m.(P2)			K-n-p(P2)	P2
	A^{41}	A	β^-, γ	110 m.(S3)	2.7(K4) cl. ch.	1.37(R8) cl. ch. recoil	A-d-p(S3) K-n-p(H5) A-n-γ(S3)	S3, K4, R8, H5
	$A^{35, 37}$	F		1.1 hr.(K3)			S-α-n(?)(K3)	K3
19	K^{38}	A	β^+, γ	7.7 m.(H5, R3)	2.3(R3) abs.		Cl-α-n(H5, R3) Ca-d-α(H5) K-n-2n(P2)	H5, R3, P2
	K^{42}	A	β^-	12.4 h.(H5)	3.5(K4) cl. ch.		K-d-p(H5) K-n-γ(H5, A1) Ca-n-p(H5) Sc-n-α(H5)	H5, K4, A1
	$K^{43, 44}$	C	β^-	18 m.(W1, W8)			Ca-n-p(W1, W8)	W1, W8
20	Ca^{39}	F	β^+	4.5 m.(P2, W8)			Ca-n-2n(?)(P2, W8)	P2, W8
	Ca^{41}	B	K, γ(W8)	8.5 d.(W8)		1.1(W8) abs. Pb	Ca-d-p(W8) Ca-n-2n(W8)	W8
	Ca^{45}	A	β^-, γ	180 d.(W8)	0.2, 0.9(W8) abs.	0.7(W8) abs.	Ca-n-γ(W8) Ca-d-p(W8, W5) Sc-n-p(W8)	W8, W5
	Ca^{47}	A	β^-, γ	2.5 h.(W8)	2.3(W8) abs.	0.8(W8) abs.	Ca-d-p(W8) Ca-n-γ(W8)	W8
	Ca^{49}	B	β^-	30 m.(W8)			Ca-d-p(W8) Ca-n-γ(W8)	W8
21	Sc^{42}	A	β^+	13.4 d.(W8)	1.4(W8) abs.		K-α-n(W8)	W8
	Sc^{43}	A	β^+	4 h.(W3)	1.3(W3) cl. ch.	1.0(W8) abs. Pb	Ca-α-p(F4, W3) Ca-d-n(W3) Ca-p-n(D2, D9)	F4, W3, D2, D9, W8
	Sc^{44}	A	I.T., ϵ^+(W8)	52 h.(W3)		0.25(W8) abs. of ϵ^+	Sc-n-2n(B9) K-α-n(W3) Ca-d-n(W3) Ca-p-n(D2, D9) Ti-d-α(W4)	B9, W3, D2, W4, D9, W8
	Sc^{46}	A	β^+	4 h.(B9)	1.6(W3) cl. ch.		Sc-n-2n(B9) K-α-n(W3) Ca-d-n(W3) Ca-p-n(D2, D9) Sc-γ-n(B20) Sc^{44}(52h.)I.T.(W8)	B9, W3, D2, D9, B20, W8
	Sc^{48}	A	β^-, γ; K(W5)	85 d.(W5)	0.26, 1.5(β^-) (W8) abs.	1.25(W8) abs. Pb	Sc-d-p(W1, W5) Sc-n-γ(W1) Ti-d-α(W1) Ca-α-p(W8) Ti-n-p(W4)	W1, W5, W8, W4
	Sc^{47}	B	β^-, γ	63 h.(W8)	1.1(W8) abs.		Ca-α-p(W8), Ti-n-p(W8)	W8
	Sc^{48}	A	β^-, γ(W8)	44 h.(W8)	0.5, 1.4(W8) abs.	0.9(W8) abs.	Ti-n-p(W4, P2, W8) V-n-α(W4, P2, W8)	W4, P2, W8
	Sc^{49}	A	β^-	57 m.(W8)	1.8(W8) abs.	No γ(W8)	Ca-d-n(W8) Ti-n-p(W8) Ca^{49}(2.5 h.)β^- decay (W8)	W8
22	Ti^{51}	A	β^-, γ(W4)	2.9 m.(W4)			Ti-d-p(W4) Ti-n-γ(W4, A1)	W4, A1
	Ti^{51}	A	β^-, γ	72 d.(W5)	0.36(W5) abs.	1.0(W5) coincid. abs.	Ti-d-p(W5) Ti-n-γ(W8)	W5, W8
23	V^{49}	B	K	600 d.(W5)	No β^+ or ϵ^-(W5)	No γ(W5)	Ti-d-n(W5)	W5

Radio-element Z	A	Class	Type of Radiation	Half-Life	Energy of Radiation (Mev) Particles	γ-rays	Produced by	Observers
23	V^{48}	A	β^+; K, γ(W5)	16 d.(W4)	1.0(W4) cl. ch.	1.05(R4) cl. ch. recoil	Ti-d-n(W4) Sc-α-n(W6) Cr-d-α(W4) Ti-p-n(D9)	W4, R4, W6, W5, D9
	V^{49}	B	β^+	33 m.(W4)	1.0(W4) abs.		Ti-d-n(W4) Ti-α-p(W4) Ti-p-n(D9)	W4, D9
	V^{50}	A	β^+	3.7 h.(W4)			V-n-2n(W4) Ti-d-n(W4) Ti-α-p(W4)	W4
	V^{51}	A	β^-	3.9 m.(W4)			V-n-γ(W4, P2, A1) V-d-p(W4) Cr-n-p(W4, P2) Mn-n-α(W4, P2, A1)	A1, W4, P2
24	Cr^{51}	B	K, ϵ^-, γ; β^+(?)(W8)	26 5 d.(W8)		0.5(?), 1(W8) coincid. abs.	Ti-α-n(W8) Cr-d-p(W8) Cr-n-γ(W8)	W8
25	Mn^{51}	A	β^+	46 m.(L7)	2.0(L7) abs.		Cr-d-n(L7) Cr-p-γ(D2, D4)	D2, L7, D4
	Mn^{52}	A	β^+, γ	21 m.(L7)	2.2(H6)	1.2(H6)	Fe-d-α(D5, L7) Cr-p-n(H6)	L7, H6, D5
	Mn^{53}	A	β^+, γ; K(H6)	6.5 d.(L7)	0.77(H6)	1.0(H6)	Fe-d-α(L7) Cr-p-n(H6)	L7, H6
	Mn^{54}	A	K, γ(L7)	310 d.(L7)		0.85(L7) abs. Pb	Fe-d-α(L7) Cr-d-n(L7) V-α-n(L7) Cr-p-n(D9)	L7, D9
	Mn^{56}	A	β^-, γ	2.59 h.(L7)	1.2, 2.9(B10) cl. ch. K. U.	1.65(M6, L29) coincid. abs.	Mn-n-γ(A1) Mn-d-p(L7) Fe-d-α(L7) Fe-n-p(A1) Co-n-α(A1) Cr-α-p(R3)	A1, L7, B10, M6, R3, L29
26	Fe^{53}	A	β^+	8.9 m.(R3)			Cr-α-n(R3) Fe-n-2n(L20)	R3, L20
	Fe^{59}	A	K, ϵ^-	~4 y.(V4)			Fe-d-p(L23) Mn-p-n(V4)	L23, V4
	Fe^{59}	A	β^-, γ	47 d.(L20)	0.4, 0.9(L20) abs.	1.0(L20) abs. Pb	Fe-d-p(L20) Co-n-p(L20)	L20
27	Co^{55}	A	β^+, γ	18.2 h.(D5)	1.50(L21) spect.	0.16, 0.21, 0.8, 1.2(C20) cl. ch. recoil	Fe-d-n(D5, L8) Fe-p-γ(L9)	D5, L8, L21, L9, C20
	Co^{56}	B	K, γ, ϵ^-(L10)	270 d.(L10)			Fe-d-2n(L9, B24, P4) Ni-d-α(L11) Fe-p-n(L9)	L10, B24, P4, L9, L11
	Co^{57}	A	β^+	70 d.(L10)			Fe-d-n(L9, B24, P4) Mn-α-n(L9) Ni-d-α(L11) Fe-p-n(L9)	L10, B24, P4, L9, L11
	Co^{60}	A	β^-, γ	7 y.(L10)	0.16, 1.5(R9) abs.	1.3(L9) abs. Pb	Co-d-p(L9, B24) Co-n-γ(R9, L9) Ni-n-p(V5)	R9, L9, L10, B24, V5
	$Co^{58, 60}$	C	β^-	11 m.(H7)			Co-n-γ(H7, L8) Ni-n-p(H8)	H7, H8, L8
28	Ni^{57}	A	β^+	36 h.(L11)	0.67(L11) abs.		Fe-α-n(L11) Ni-n-2n(?)(L11)	L11
	Ni^{63}	A	β^-, γ	2.6 h.(L11)	1.9(L11) abs.	1.1(L11) abs. Pb	Ni-d-p(L11) Ni-n-γ(H8) Cu-n-p(H8) Zn-n-α(H8) Ni-n-2n(H8)	L11, H8
29	$Cu^{58, 60}$	C	β^+	81 s.(D4)			Ni-p-n(D4)	D4
	$Cu^{59, 62}$	C	β^+	7.9 m.(D4)			Ni-p-n(D4)	D4
	Cu^{61}	B	β^+; K(A4)	3.4 h.(T1, R3)	0.9(R3) abs.	No γ(G2)	Ni-d-n(T1) Ni-p-n(D4) Ni-p-γ(D4) Ni-α-p(R3)	T1, D4, R3, G2, A4
	Cu^{62}	A	β^+	10.5 m.(H8)	2.6(C13) cl. ch.		Cu-n-2n(H8) Cu-γ-n(B20) Co-α-n(R3) Ni-p-n(S18) Ni-p-γ(S18)	H8, B20, R3, S18, C13
	Cu^{64}	A	β^-; β^+; K(A4)	12.8 h.(V2)	0.58(β^-), 0.66(β^+)(T6) spect.	No γ(T6)	Cu-d-p(V2) Cu-n-γ(H8) Cu-n-2n(H8) Ni-p-n(S18, D4) Zn-n-p(H8)	V2, H8, T6, S18, D4, A4
	Cu^{66}	A	β^-	5 m.(A1)	2.9(S5) cl. ch. K. U.		Cu-n-γ(A1) Zn-n-p(H8) Ga-n-α(C5)	A1, H8, C5, S5
30	Zn^{63}	A	β^+	38 m.(D4, B20)	2.3(S18) abs.		Zn-n-2n(H8, P2) Zn-γ-n(B20), Cu-d-2n(L33) Cu-p-n(S18, D4) Ni-α-n(R3)	H8, B20, P2 D4, R3, S18 L33

Radio-element		Class	Type of Radiation	Half-life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
30	Zn^{65}	A	β^+; K, γ, ϵ^-	250 d.(L12)	0.4(β^+)(D9) cl. ch.	1.0(L12) abs. Pb	Zn-d-p(L12) Cu-d-2n(P4) Cu-p-n(B12) Zn-n-γ(S6) Ga^{65} K decay (L10)	L12, P4, B12, S6, D9, L10
	Zn^{69}	A	I.T., γ(K11)	13.8 h.(L12)		0.47(K11) abs. Pb	Zn-d-p(L12, K11, V7) Zn-n-γ(T2, L12) Ga-d-α(L12) Ga-n-p(L12)	L12, T2, K11, V7
	Zn^{69}	A	β^-	57 m.(L12)	1.0(L12) abs.	No γ(L12)	Zn-d-p(L12, K11, V7) Zn-n-γ(T2) Ga-d-α(L12) Ga-n-p(L12) Zn^{69}(13.8 h.) I.T. (K11)	L12, H8, T2, K11, V7
31	Ga^{61}	B	β^+	48 m.(B13)			Zn-p-n(B13)	B13
	Ga^{64}	A	K, ϵ^-	15 m.(A4, L10)			Zn-d-n(A4, L10)	A4, L10
	Ga^{66}	A	β^+	9.4 h.(B13, R3)	3.1(M7) abs.		Cu-α-n(M7, R3) Zn-p-n(B13)	M7, B13, R3,
	Ga^{67}	A	K, γ, ϵ^-	83 h.(A4)		0.0925(V7, H25) spect. conv.; 0.1, 0.25(A4) abs. Cu, Pb	Zn-d-n(A4, G6, V7) Zn-α-p(M8) Zn-p-n(B13, V7)	A4, M8, B13, G6, V7, H25
	Ga^{68}	A	β^+	68 m.(R3)	1.9(R3, M7) abs.		Cu-α-n(R3, M7) Ga-n-2n(P2) Ga-γ-n(B20) Zn-p-n(D2, B13) Zn-p-γ(?)(D2) Zn-d-n(G6, V7)	R3, P2, B20, D2, M7, B13, G6, V7
	Ga^{70}	A	β^-, ϵ^-, γ	20 m.(B20, A1)	5.0(β^-)(M8) abs.	0.054, 0.117(V7) spect. conv.	Ga-n-γ(A1) Ga-n-2n(P2) Ga-γ-n(B20) Zn-p-n(D2, V7) Zn-α-p(M8)	A1, P2, B20, D2, M8, B13, V7
	Ga^{72}	A	β^-, γ	14 h.(S6, L20)	2.6(L28) abs.	1.0(S7) abs. Pb	Ga-d-p(L20) Ga-n-γ(S6)	S6, S7, L20, L28
32	Ge^{68}	E	β^+	29 m.(S6)			Ge-n-2n(S6)	S6
	Ge^{71}	B	β^+	37 h.(M8)	1.0(M8) abs.		Zn-α-n(M8) Ge-n-γ(S6) Ge-d-p(S6) Ga-d-2n(L28)	M8, S6, L28
	$Ge^{67, 69, 71}$	E		195 d.(M8)			Zn-α-n(M8)	M8
	$Ge^{69, 73}$	E	β^-	81 m.(S6)			Ge-n-γ(S6) Ge-d-p(S6)	S6
	$Ge^{69, 73}$	E	β^-	8 h.(S6)			Ge-n-γ(S6)	S6
	$Ge^{69, 71}$	C		6–10 d.(S6, L28)			Ge-n-?(S6) Ga-d-2n(L28)	S6, L28
33	$As^{71, 73}$	F	β^+	50 h.(S6)			Ge-d-n(S6)	S6
	$As^{71, 73}$	F	β^+	88 m.(S6)			Ge-d-n(S6)	S6
	As^{72}	E	β^+	26 h.(V4)			Ge-p-n(V4)	V4
	As^{74}	A	β^-, β^+	17 d.(S8)	1.2(β^-), 0.9(β^+)(S8) cl. ch. K. U.		As-n-2n(S8, C11) Ge-d-n(S8) Se-d-α(F8)	S8, C11, F8
	As^{76}	A	β^-, γ; β^+; K, γ(?) (S23)	26.8 h.(W9)	1.1, 1.7, 2.7 (β^-)(S23, W9); 0.7, 2.6(β^+) (S23) cl. ch.	3.2, 2.2, 1.5 (S23) cl. ch. pair	As-d-p(C11, T3) As-n-γ(C11) Br-n-α(C11) Ge-p-n(V4) Se-d-α(F8)	C11, T3, S23, W9, V4, F8
	As^{77}	D	β^-, γ(S6)	55 d.(S6)			Ge-d-n(S6, S8)	S8, S6
	As^{78}	A	β^-	65 m.(S9)			Br-n-α(S9, C11)	S9, C11
34	Se^{75}	A		48 d.(D9)			As-p-n(D9)	D9
	$Se^{79, 81}$	C	I.T., ϵ^-(L32)	57 m.(S9, L32)		0.093 (L32) spect. conv.	Se-d-p(S9, L32) Se-n-γ(S9, H10) Br-n-p(S9, L32) Se-γ-n(B20)	S9, H10, B20, L32
	$Se^{79, 81}$	C	β^-	19 m.(L32)	1.5(L32) abs.		Se-d-p(S9, L32) Se-n-γ(S9, H10) Se-γ-n(B20) Br-n-p(L32)	B20, S9, H10, L32
	Se^{83}	A	β^-	30 m.(L32)			$Se^{79, 81}$(57 m.) I.T.(L32) Se-d-p(L32) Se-n-γ(L32)	L32
	Se	D		sev. h.(B15)			Th-n(B15)	B15
	Se	D		sev. d.(B15)			Th-n(B15)	B15
35	Br^{76}	A	β^+, ϵ^-, γ	6.4 m.(S9)	2.3(β^+)(S9) abs	0.046, 0.108 (V7) spect. conv.	Se-d-n(S9) As-α-n(S9) Br-γ-n(B20, C5) Br-n-2n(H10) Se-p-n(B13, V7)	S9, C5, B20, H10, B13, V7
	Br^{80}	A	I.T., ϵ^- (S10, V3, V7)	4.4 h.(B13)		0.049; 0.037 or 0.025(V7) spect. conv.	Br-n-γ(S9, S10, A2) Br-d-p(S9) Se-p-n(B13, V7) Br-γ-n(B20) Br-n-2n(P2)	S9, S10, A2, B13, B20, P2, V7, D19

Radio-element		Class	Type of Radiation	Half-Life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
35	Br^{80}	A	β^-, γ	18 m.(S9, S10)	2.0(A2) spect.	<0.5 (B13, S9) abs.	Br-n-γ(S9) Br-d-p(S9) Se-p-n(B13) Br-γ-n(B20) Br-n-2n(P2) Br^{80}(4.4 h.) *I.T.*(S10)	S9, S10, V3, A2, B13, B20, P2
	Br^{82}	A	β^-, γ	34 h.(S9)	0.7(B13)	0.65(K5) cl. ch. recoil and abs.	Br-n-γ(K5, S9) Br-d-p(S9) Se-p-n(B13) Se-d-2n(S9) Rb-n-α(S9, P2)	S9, K5, B13, P2
	Br^{83}	A	β^-	140 m.(L32)	1.05(L32) abs.	No γ(S9)	Se-d-n(S9) Se^{83} β^- decay (S9, L32) Th-n(B15, L32) U-n(L32)	S9, B15, L32
	$Br^{>83}$	D		40 m.(D6)			U-n(D6, H22)	D6, H22
	$Br^{>83}$	F		22 h.(B15)			Th-n(B15)	B15
	$Br^{>83}$	D		3.8 h.(H22)			U-n(H22)	H22
36	$Kr^{79, 81}$	E		18 h.(S9)			Kr-d-p(S9)	S9
	Kr^{81m}	A	*I.T.*, ϵ^-	113 m.(L32)		0.049(L32) abs. of ϵ^-	Br^{81} β^- decay (L32)	L32
	$Kr^{83, 87}$	E	β^-	74 m.(S9)			Kr-d-p(S9) Se-α-n(?)(K3)	S9, K3
	$Kr^{85, 87}$	E	β^-	4.5 h.(S9)			Kr-d-p(S9) Se-α-n(?)(K3)	S9, K3
	Kr(?)	F		1-2 m.(K3)			Se-α-n(?)(K3)	K3
	Kr^{85}	A	β^-	3 h.(L27)			Th-n(A5, L27) U-n(H22, H11)	H22, H11, A5, L27
37	$Rb^{83, 84}$	F	β^+	1.5 m.(R3)			Br-α-n(?)(R3)	R3
	$Rb^{83, 84}$	F	β^+	9.8 m.(R3)			Br-α-n(?)(R3)	R3
	Rb^{86}	A	β^-	18 m.(S9)			Rb-n-γ(S9, P2) Pa-n(G7) Kr^{85} β^- decay (L27, H11, A5)	S9, P2, H11, A5, L27, G7
	$Rb^{86, 88}$	C	β^-	18 d.(S9)			Rb-n-γ(S9)	S9
38	Sr^{85}	B	*K*, γ(D9)	~60 d.(D18)			Rb-p-n(D18)	D18, D9
	Sr^{85}	B	*K*, γ(D9)	70 m.(D9)			Rb-p-n(D9)	D9
	Sr^{87m}	A	*I.T.*, ϵ^-, γ(D18)	2.7 h.(D18)		0.37(D18) spect. conv.	Rb-p-n(D18) Sr-d-p(D18) Sr-n-γ(D18) Y^{87} (85 h.) *K* decay	D18
	Sr^{89}	A	β^-	55 d.(S28)	1.50(S28) cl. ch.	No γ(S28)	Sr-d-p(S11, S28) Sr-n-γ(S11, S28) Y-n-p(S12) U-n(L26)	S11, S12, L26, S28
	$Sr^{>90}$	D	β^-	7 m.(L26)			U-n(L26)	L26
	$Sr^{>90}$	D	β^-	6 h.(L26)			U-n(L26)	L26
39	Y^{86}	B	*K*(D9)	80 d.(D9)			Sr-p-n(D9)	D9
	Y^{87}	B	*K*(D9)	14 h.(S28, D9)			Sr-d-n(S28, D9) Sr-p-n(D9)	S28, D9
	Y^{87}	A	*K*, γ, ϵ^-(D18)	85 h.(D18)			Sr-p-n(D18) Sr-d-n(D18, S28)	D18, S28
	Y^{88}	A	β^+	2.0 h.(S28)	1.2(S11) cl. ch. K. U.		Sr-d-n(S11, S28) Y-n-2n(S11)	S11, S28
	Y^{90}	A	β^-	60 h.(S11)	2.6(S11) cl. ch. K. U.		Y-d-p(S11) Y-n-γ(S11, S12) Cb-n-α(S13)	S11, S12, S13
	Y	D	β^-	70 h.(S12)	1.3(S12) cl. ch. K. U.		Zr-n-p(S12) Zr-d-α(?)(S12)	S12
	$Y^{>90}$	D		3.5 h.(L26)			$Sr^{>90}$ (6 h.) β^- decay (L26)	L26
	Y	E		80 d.(D9)			Sr-p-n(?)(D9)	D9
40	Zr^{89}	A	β^+(S12, D9)	70 h.(S12, D9)	1.0(β^+)(S12) cl. ch. K. U.		Zr-n-2n(S12) Y-p-n(D9)	S12, D9
	Zr^{93}	A	γ; *I.T.* or *K*(D9)	4 m.(D9)			Y-p-n(D9)	D9
	Zr	D	β^-	17–40 h. (S12, H13)	1.25(S12) cl. ch. K. U.		Zr-n-γ(H13, S12)	S12, H13
	Zr	F		10–30 m.(P2, S12)			Zr-n-?(P2, S12)	S12, P2
	Zr	F	β^-	2.5–5 h (S12, P2)			Zr-n-?(S12, P2) Zr-d-?(S12)	S12, P2
	Zr	F	β^-	90 m.(S12)			Zr-d-?(S12)	S12
41	Cb	E		4 m.(D9)			Zr-p-n(?)(D9)	D9
	Cb	E		12 m.(D9)			Zr-p-n(?)(D9)	D9
	Cb	E		38 m.(D9)			Zr-p-n(?)(D9)	D9
	Cb	E		21 h.(D9)			Zr-p-n(?)(D9)	D9
	Cb	E		96 h.(D9)			Zr-p-n(?)(D9)	D9
	Cb^{89}	B	β^-	11 d.(S13)	1.0(S13) cl. ch. K. U.		Cb-n-2n(S13)	S13
	Cb^{94}	E	β^-	7.5 m.(S13)			Cb-n-γ(S13, P2)	S13, P2
42	Mo^{93}	F		7 h.(D9)			Cb-p-n(?)(D9)	D9
	$Mo^{91, 93}$	C	β^+	17 m.(B20, S12)	1.8(S12) cl. ch. K. U.		Mo-n-2n(H10, S12) Mo-γ-n(B20)	S12, B20, H10

* Radioactive isomer of stable nucleus.

Radio-element		Class	Type of Radiation	Half-Life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
42	$Mo^{93,101}$	C	β^-, γ	67 h.(S14)	1.5(S14) abs.	0.4(S14) abs.	Mo-d-p(S14) Mo-n-γ(S14, S12) U-n(H23) Th-n(H124)	S14, S12, H23, H24
	Mo^{101}	B	β^-	24 m.(S12)	1.3(S12) cl. ch. K. U.		Mo-n-γ(H10, S12)	S12, H10
43	43[98]	B	β^+(?)	2.7 h.(D4)			Cb-α-n(K3) Mo-p-n(D4) Mo-d-n(S14)	K3, D4, S14
	$43^{99,101}$	C	I.T., ϵ^-, γ(S14)	6.6 h.(S14)		~0.136(S14) spect. conv. ~0.18(S14) abs.	$Mo^{99,101}$ (67 h.) β^- decay (S14)	S14
	43	D	K, ϵ^-	90 d.(C12)			Mo-d-n(C12, C24)	C12, C24
	43	D	K, γ	62 d.(C12)			Mo-d-n(C12, C24)	C12, C24
	43	D	K(?), ϵ^-, γ(E5)	110 h.(E3)	0.6(E3)	0.05, 0.5(E5)	Mo-p-n(E3, E5)	E3, E5
	43	E	β^-, γ(E3)	55 m.(E5)	2.5(E5) abs.		Mo-p-n(E3, D4, F5)	E3, D4, E5
	43	E	β^-	36.5 h.(D4)			Mo-p-n(D4)	D4
	43	E	β^-	18 s.(D9)			Mo-p-n(D3, D9)	D3, D9
	43	D	K	~2 d.(S14)			Mo-d-n(S14)	S14
44	Ru[96]	F		20 m.(D7)			Ru-n-2n(?)(D7, P2)	D7, P2
	Ru[100]	B	β^-	4 h.(D7, L13)			Ru-n-γ(D7) Ru-n-2n(D7, P2) Ru-d-p(L13)	D7, P2, L13
	Ru[106]	B	β^-	20 h.(D7)			Ru-n-γ(D7)	D7
	Ru	F	β^-	39 h.(L13)			Ru-d-?(L13)	L13
	Ru	G		11 d.(L13)			Ru-d-?(L13)	L13
	Ru	E		90 m.(K3)			Mo-α-n(K3)	K3
45	Rh[104]	A	I.T., ϵ^-(P5)	4.2 m.(S29)		0.055–0.080(P5) abs. of ϵ^-	Rh-n-γ(P5, A1, P2) Ru-p-n(D9)	P5, C13, A1, P2, D9, S29
	Rh[104]	A	β^-	44 s.(P5, A1)	2.3(C13) cl. ch.		Rh-n-γ(P5, A1) Rh^{104} (4.2 m.) I.T.(P5) Ru-p-n(D9) Ag-n-α(G3)	P5, C13, G3, A1, D9
	Rh[105]	B	β^-	46 d.(L13)			Ru^{105} β^- decay (D7) Ru-d-n(L13)	D7, L13
	Rh	G	β^-	1.1 h.(P2)			Rh-n-?(P2)	P2
	Rh	E		3 h.(D9)			Ru-p-n(?)(D9)	D9
	Rh	E		10.7 h.(D9)			Ru-p-n(?)(D9)	D9
	Rh	E		3 d.(D9)			Ru-p-n(?)(D9)	D9
46	$Pd^{107,109}$	C	β^-	13 h.(K6)	1.03(K6) cl. ch.		Pd-d-p(K6) Pd-n-γ(A1, K6) Ag-n-p(F5)	K6, A1, F5
	Pd[111]	A	β^-	17 m.(K6)			Pd-d-p(K6, A1) Pd-n-γ(K6, A1)	K6, A1
47	Ag[103]	E		73 m.(E6)			Pd-p-n(E6)	E6
	Ag[104]	E		16.3 m.(E6)			Pd-p-n(E6)	E6
	Ag[105]	E	K	45 d.(E6)		0.29, 0.42, 0.50, 0.62 (E6) spect.	Pd-p-n(E6)	E6
	Ag[106]	A	β^+	24.5 m.(P6, D21)	2.04(F5) abs.	No γ(F5)	Ag-n-2n(P6) Pd-d-n(P6) Cd-n-p(P6) Rh-α-n(P6, K3) Ag-γ-n(B20) Pd-p-γ(D2) Pd-p-n(D2, E6)	P6, B20, D2, F5, K3, E6
	Ag[108]	A	K(?), ϵ^-, γ (P6, A4, F5)	8.2 d.(P6, K6)	1.2(ϵ^-), (F5) abs.	1.06, 0.69 E(6) spect.	Ag-n-2n(P6, K6) Pd-d-n(P6, K6) Rh-α-n(P6) Pd-p-n(D2, E6) Cd-n-p(P6)	P6, R2, D2, F5, K6, A4, E6
	Ag[109]	A	β^-	2.3 m.(A1, B20)	2.8(N4) cl. ch.		Ag-n-γ(A1) Ag-γ-n(B20) Pd-p-n(D2, E6) Cd-n-p(P6) Ag-d-p(K12)	A1, B20, N4, D2, P6, E6, K12
	Ag[110]	A	β^-, γ(P6)	22 s.(A1, P6)	2.8(G4) cl. ch. K. U.		Ag-n-γ(A1) Cd-n-p(P6)	A1, G4, P6
	Ag[106, 110]	C	β^-	225 d.(L14, R10)			Ag-n-γ(R10, L14, A8, M12) Ag-d-p(K12)	R10, L14, A8, M12, K12
	Ag[111]	A	β^-	7.5 d.(K6, P6)		No γ (K6, P6)	Pd-d-n(K6, P6) Pd-α-p(P6) Cd-n-p(P6, Pd^{111} β^- decay (K6)	K6, P6
	Ag[117]	A	β^-, γ	3.2 h.(P6)	2.2(P6) cl. ch.		Cd-n-p(P6) In-n-α(P6)	P6
48	$Cd^{107,109}$	C	K, ϵ^-, γ(D4, V7, W11)	6.7 h.(D4, R5)		0.093(V7) spect. conv. 0.53(V7) abs. Pb	Ag-p-n(D4, R5, V7, W11) Ag-d-n(K12)	D4, R5, V7, K12, W11

Radio-element		Class	Type of Radiation	Half-Life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
48	Cd^{109}	E	β^+	33 m.(P2)			Cd-n-2n(P2)	P2
	Cd^{115}	A	β^-, γ	2.5 d.(G5)	1.11(C14) spect.	0.8(C14) cl. ch. recoil	Cd-d-p(C14) Cd-n-γ(G5, M10) Cd-n-2n(G5)	G5, C14, M10
	Cd^{117}	A	β^-	3.75 h.(C14)			Cd-d-p(C14) Cd-n-γ(M10, G5)	G5, C14, M10
	Cd*	D	I.T., e^-	50 m.(D8)			Cd-n-n(D8)	D8
49	In^{110}	D	β^+	65 m.(B17)	1.6(B17) spect.		Cd-p-n(B17) Ag-α-n(K9)	B17, K9
	In^{113}	D	β^+, γ, e^-	20 m.(B17, L15)	2.15(β^+) (C14) cl. ch	0.16(B17) spect. conv.	Cd-d-2n(?)(L15) Cd-p-n(B17) Ag-α-n(K3, K9)	L15, B17, K3, C14, K9
	In^{113}	B	β^-	72 s.(L15, B17)			In-n-2n(L15, P2) In-γ-n(B11, C5) Cd-p-n(B17)	C5, B11, P2, L15, B17, K9
	In^{111}	D	β^-, γ, e^-(B17)	2.7 d.(B17, C14)	1.73(β^+)(D9)	0.17, 0.25 (B17, C14) spect. conv.	Cd-p-n(B17) In-n-2n(?)(C14)	B17, C14, D9
	In^{111m}	A	I.T., γ, e^-(B17)	105 m.(B17)		0.39(B17) spect. conv.	Cd-p-n(B17) Sn^{113} K decay (B17, S22)	B17, S22
	In^{111}	B	β^-, γ, e^-	48 d.(B17)	1.75(β^-) (C14) cl. ch.	0.19(B17) spect. conv.	In-n-γ(L15, M12) Cd-p-n(B17)	M12, L15, B17, C14
	In^{115m}	A	I.T., e^-, γ(C14)	4.1 h.(G5, B18)		0.34(C14) spect. conv.	In-n-n(G5) In-p-p(B18) In-α-α(L16) In-x-rays (P7, C10) Cd^{115} β^- decay (G5)	G5, B18, L16, C14, P7, C10
	In^{116}	B	β^-	13 s.(A1, C14)	2.8(C14) cl. ch.	No γ(M11)	In-n-γ(A1, L15) In-d-p(L15) Cd-p-n(D9)	A1, C14, M11, L15, D9
	In^{116}	B	β^-, γ	54 m.(A1, L15)	0.85(C14) spect.	1.8, 1.3, 1.0, 0.4, 0.2(C15) cl. ch. recoil	In-n-γ(A1, M11) Cd-p-n(B17) In-d-p(L15)	A1, M11, L15, C15, B17, C14
	In^{117}	A	β^-, γ, e^-	2.1 h.(C14)	1.73(β^-) (C14) spect.	0.388(C14) spect. conv.	Cd^{117} β^- decay (G5) Cd-d-n(C14)	G5, C14
50	Sn^{113}	A	K, e^-, γ	70–105 d.(L17, B17)		0.085(B17) spect. conv.	In-p-n(B17) Sn-d-p(L17) Cd-α-n(L17)	B17, L17
	Sn^{m119}	E	β^-	25 m.(L17)			Cd-α-n(L17)	L17
	Sn^{m119}	E	β^-	3 h.(L17)			Cd-α-n(L17)	L17
	Sn^{m119}	E	β^-	13 d.(L17)			Cd-α-n(L17)	L17
	Sn^{m123}	D	β^-	40 m.(L17)			Sn-d-p(L17) Sn-n-γ(L17) Sn-n-2n(P2)	L17, P2
	Sn^{m125}	D	β^-	26 h.(L17)			Sn-d-p(L17) Sn-n-γ(L17)	L17
	Sn^{m126}	D	β^-	10 d.(L17)			Sn-d-p(L17) Sn-n-γ(L17)	L17
	Sn^{m129}	D		~400 d.(L17)			Sn-d-p(L17)	L17
	Sn^{131}	B	β^-	9 m.(L17)			Sn-d-p(L17) Sn-n-γ(L17)	L17
51	Sb	E	β^-	3.5 m.(D9)			Sn-p-n(D9)	D9
	Sb^{111}, 113	E	β^+	5 m.(L16)			In-α-n(L16)	L16
	Sb^{199}	A	β^+	17 m.(H10, L18)	1.53(A10) cl. ch.		Sb-n-2n(P2, H10) Sb-γ-n(B20) Sn-d-n(L18) Sn-p-n(D9)	H10, B20, P2, L18, A10, D9
	Sb^{122}	A	β^-	2.8 d.(L28)	1.64(A10) cl. ch.	0.5(L28) abs. Pb	Sb-d-p(L18) Sb-n-γ(A1, L18) Sn-d-2n(L18) Sn-p-n(D9)	L18, A1, A10, D9, L28
	Sb^{124}	A	β^-	60 d.(L18)	1.8(L28) abs.	0.8(L28) abs. Pb	Sb-d-p(L18) Sb-n-γ(L18) I-n-α(L18)	L18, L28
	Sb^{m125}	D	β^-	3 h.(L18)			Sn-d-n(L18)	L18
	Sb^{m126}	D		~45 d.(L18)			Sn-d-n(L18)	L18
	Sb^{m126}	D		~2 y.(L18)			Sn-d-n(L18)	L18
	Sb^{127}	A	β^-	80 h.(A6)			U-n(A6)	A6
	Sb^{129}	A	β^-	4.2 h.(A6)			U-n(A6)	A6
	Sb^{m131}	D	β^-	<10 m.(A6)			U-n(A6)	A6
	Sb^{m131}	D	β^-	<10 m.(A6)			U-n(A6)	A6
	Sb^{m133}	D	β^-	5 m.(A6)			U-n(A6)	A6
52	Te^{121}	A	K, e^-	120 d.(S15)			Sb-d-2n(S15), Sn-α-n(L10) Sb-p-n(S15)	S15, L10
	Te^{127}	A	I.T.(S15)	90 d.(S15)			Te-d-p(S15) I-n-p(S15)	S15
	Te^{129}	A	β^-	10 h.(S15, T4)			Te-d-p(S15, T4) I-n-p(S15) Te-n-2n(T4) Te^{127} (90 d.) I.T. (S15) Sb^{127} β^- decay (A6)	S15, A6, T4
	Te^{131}	A	I.T.(S15)	30 d.(S15, T4)			Te-d-p(S15, T4) Te-n-2n(T4)	S15, T4

* Radioactive isomer of stable nucleus.

Radio-element		Class	Type of Radiation	Half-Life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
52	Te^{130}	A	β^-	70 m.(S15, A6)			Te-d-p(S15, T4) Te-γ-n(B20) Te-n-2n(H10, T4) Te^{130} (30 d.) *I.T.* (S15) Sb^{130} β^- decay (A6)	S15, B20, H10, A6, T4
	Te^{131}	A	*I.T.*(S15)	30 h.(S15, A6)			Te-d-p(S15) U-n(A6, H22)	S15, A6, H22
	Te^{131}	A	β^-	25 m.(S15)			Te-d-p(S15) Te-n-γ(S15) U-n(A6) Te^{131} (30 h.) *I.T.* (S15)	S15, A6
	$Te^{>131}$	D	β^-	43 m.(A6)			$Sb^{>131}$ (<10 m.) β^- decay (A6, H22)	A6, H22
	$Te^{>131}$	D	β^-	60 m.(A6)			$Sb^{>131}$ (<10 m.) β^- decay (A6, H22)	A6, H22
	$Te^{>131}$	D	β^-	77 h.(A6)			$Sb^{>131}$ (5 m.) β^- decay (A6, H22) Th-n(H24)	A6, H22, H24
	$Te^{>131}$	D	β^-	~0.5 h.(S21)			U-n(S21)	S21
53	I^{124}	A	β^+	4.0 d.(L19, D9)			Sb-α-n(L19) Te-p-n(D9)	L19, D9
	I^{126}	A	β^-, γ	13.0 d.(L19, T4)	1.1(L19) abs.	0.5(L19) abs. Pb	Sb-α-n(L19) I-n-2n(T4, L19) Te-d-n(L19) Te-p-n(D9)	L19, T4, D9
	I^{128}	A	β^-, γ	25 m.(A1)	1.2, 2.1(B19) cl. ch.	0.4(L19) abs. Pb	I-n-γ(A1, T4) Te-d-2n(L19) Te-p-n(D9)	A1, L19, B19, D9, T4
	I^{130}	A	β^-, γ	12.6 h.(L19)	0.83(T7) cl. ch.	0.6(L19) abs. Pb	Te-d-2n(L19) Te-p-n(D9)	L19, D9, T7
	I^{131}	A	β^-, γ	8.0 d.(L19)	0.687(T7) cl. ch.	0.4(L19) abs. Pb	Te-d-n(L19) Te^{131} β^- decay (S15, A6, H22)	L19, S15, T7, A6, H22
	$I^{>131}$	D	β^-	2.4 h.(A6)			$Te^{>131}$ (77 h.) β^- decay (A6, H22)	A6, H22
	$I^{>131}$	D	β^-	54 m.(A6)			$Te^{>131}$ (43 m.) β^- decay (H22, A6) Th-n(D6)	H22, D6, A6
	$I^{>131}$	D	β^-	6.6 h.(S21)			$Te^{>131}$ (~0.5 h.) β^- decay(S21)	S21
	$I^{>131}$	D	β^-	22 h.(A6)			$Te^{>131}$ (60 m.) β^- decay (H22, A6, S21)	A6, H22, S21
54	Xe^{127}	E		~100 s.(W11)			I-p-n(W11)	W11
	Xe^{129}	A	β^-	<0.5 m.(H11, H12)			U-n(H22, H11) Th-n(A5)	H11, H22, A5, H12
	$Xe^{>129}$	D	β^-	~15 m.(H22)			U-n(H22, H11) Th-n(A5)	H11, A5, H22
	$Xe^{>131}$	D		4.5 d.(S21)			$I^{>131}$ (22 h.) β^- decay (S21)	S21
	$Xe^{>131}$	D		9.4 h.(S21)			$I^{>131}$ (6 h.) β^- decay (S21)	S21
55	Cs^{131}	A		1.5 h.(A1)			Cs-n-γ(A1, M16)	A1, M16
	Cs^{134}	A		~1 y.(A8)			Cs-n-γ(A8, S20)	A8, S20
	Cs^{138}	A	β^-	6 m.(H22)			Xe^{138} β^- decay (H22, H12, H11, A5)	H22, H11, A5, H12
	$Cs^{>138}$	D	β^-	33 m.(H22)			$Xe^{>138}$ (~15 m.) β^- decay (H22, H11, H12, A5) Pa-n(G7)	H22, H11, H12, A5, G7
56	Ba	D	ϵ^-, γ	30 h.(K10)		0.23(K10) abs.	Ba-n-γ(K10)	K10
	Ba^{128}	A	β^-	86 m.(P8, H22)			Ba-d-p(P8) Ba-n-γ(A1, P2) La-n-p(P8) Cs^{128} β^- decay (H22, H11, A5, H12)	P8, A1, P2, H22, H12, H11, A5
	Ba	F		3 m.(A1, P2)			Ba-n-?(A1, P2)	A1, P2
	$Ba^{>139}$	D	β^-	300 h.(H22)			$Cs^{>139}$ (33 m.) β^- decay (H22, H11, H12, A5) Th-n(H24)	H22, H14, H12, H11, A5, H24
	$Ba^{>140}$	D	β^-	14 m.(H22)			U-n(H22, H12, H14) Th-n(H15, H14)	H22, H14, H12, H15
	$Ba^{>140}$	E	β^-	<1 m.(H14)			U-n(H14)	H14
57	La^{128}	F		2.2 h.(P2)			La-n-2n(?)(P2)	P2
	La^{140}	A	β^-	31 h.(P9)	0.8(P9) cl. ch.		La-d-p(P8) La-n-γ(P9, M13)	P8, P9, M13
	$La^{>140}$	D	β^-	~2.5 h.(H22)			$Ba^{>140}$ (14 m.) β^- decay (H22, H14, H15) U-n(B15) Th-n(C16)	H22, H14, H15, C16, B15
	$La^{>140}$	E	β^-	<30 m.(H14, H15)			$Ba^{>140}$ (<1 m.) β^- decay (H14, H15)	H14, H15
	$La^{>139}$	D	β^-	36 h.(H22)			$Ba^{>139}$ (300 h.) β^- decay (H22, H14, B15)	H22, H14, B15

Radio-element		Class	Type of Radiation	Half-Life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
58	Ce^{139}	F	β^+	2.1 m.(P9)			Ce-n-2n(?)(P9)	P9
	$Ce^{141, 143}$	C		15 d.(R11)	0.12(R11) spect.		Ce-n-γ(R11)	R11
59	$Pr^{140, 142}$	C	β^+	3.5 m.(P9)			Pr-n-2n or Pr-n-γ(P9, A1)	P9, A1
	Pr^{142}	A	β^-	18.7 h.(P9)			Pr-n-γ(P9, P2, M13, A1) Nd-n-p(P9, P2)	P9, P2, M13, A1
60	Nd^{147}	E	β^-	84 h.(P9)			Nd-d-p(P9) Nd-n-γ(P9) Nd-n-2n(?)(P9)	P9
	Nd^{149}	E	β^-	2.0 h.(P9)			Nd-d-p(P9) Nd-n-γ(P9) Nd-n-2n(?)(P9)	P9
	Nd^{151}	E	β^-	21 m.(P9)			Nd-n-γ(P9, M18)	P9, M18
61	61	F	β^-	12.5 h.(P9)			Nd-d-n(P9)	P9
62	Sm	D	β^-	21 m.(P9)			Sm-n-γ(P9, A1, M13, H17) Sm-n-2n(?)(P9)	P9, A1, H17, M13
	Sm	D	β^-	46 h.(P9)			Sm-n-γ(P9, H20, R11, H17) Sm-n-2n(?)(P9)	P9, H20, H17, R11
63	Eu^{150}	E	β^+	27 h.(P9)			Eu-n-2n(?)(P9, R11)	P9, R11
	$Eu^{151, 153}$	C	β^-, γ, ϵ^-(T6); K(?)(R2)	9.2 h.(P9)	1.88(β^-)(T6) spect.	0.123, 0.163, 0.725(T6) spect. conv.	Eu-n-γ(P9, M13, H17, H20) Eu-n-2n(?)(P9) Eu-d-p(F7)	P9, R2, H17, T6, M13, H20, F7
	$Eu^{152, 154}$	C	β^-, γ(R11, F7)	>1 y.(F7, S20)	0.8(R11) spect.		Eu-n-γ(S20, R11, F7)	S20, R11, F7
	$Eu^{153, 154}$	E		12 m.(F7)			Eu-d-p(F7)	F7
	$Eu^{152, 155}$	E		105 m.(F7)			Eu-d-p(F7)	F7
64	$Gd^{153, 161}$	E		8 h.(A1, H17)			Gd-n-γ(A1, H20, H17)	A1, H17, H20
65	Tb^{160}	A	β^-	3.9 h.(H16, M13)			Tb-n-γ(H17, P9, M13, H20)	H17, P9, M13, H20
66	Dy^{165}	A	β^-	2.5 h.(H17, P9, M13)	1.9(N4) cl. ch.		Dy-n-γ(H17, H20, P9, M13)	H17, H20, P9, M13, N4
	Dy(?)	F	β^+	2.2 m.(P9)			Dy-n-?(P9)	P9
67	Ho^{164}	F	β^-	47 m.(P9)			Ho-n-2n(?)(P9)	P9
	Ho^{166}	B	β^-	35 h.(H17)	1.6(H20) abs.		Ho-n-γ(H17, H20, P9)	H17, H20, P9
68	Er^{169}	F	β^+	1.1 m.(P9)			Er-n-2n(?)(P9)	P9
	$Er^{169, 171}$	C		7 m.(M13)			Er-n-γ(M13, M18)	M13, M18
	$Er^{169, 171}$	C	β^-	12 h.(H17, P9)			Er-n-γ(H17, H20, P9, R12)	H17, P9, R12, H20
69	Tm^{170}	A		105 d.(H20)			Tm-n-γ(H20, N7)	H20, N7
70	$Yb^{175, 177}$	C		3.5 h.(H17, M13)			Yb-n-γ(H20, H17, M13, P9)	H20, H17, M13, P9
	Yb(?)	G		41 h.(P9)			Yb-n-γ(?)(P9)	P9
71	$Lu^{170, 177}$	C		4 h.(H17, H20, M13)			Lu-n-γ(H20, H17, M13, M18)	H20, H17, M13, M18
	$Lu^{176, 177}$	C		6 d. (H17, H20, F6)			Lu-n-γ(H17, H20, F6)	H20, H17, F6
	Rare Earth	F		2.3 d.(S4)			U-n(M19, S4)	M19, S4
72	Hf^{181}	A	β^-	55 d.(H19)			Hf-n-γ(H19)	H19
73	Ta^{180}	A		14–21 m. (B11, O1)			Ta-γ-n(B11) (Ta-n-2n)(?)(O1)	B11, O1
	Ta^{180}	A	K, ϵ^-, γ(O1); β^-(?)	8.2 h.(O1)	<0.5(ϵ^-)? (O1) abs.		Ta-n-2n(O1, P2)	O1, P2
	Ta^{182}	A	β^-	97 d.(O1)			Ta-n-γ(O1, F6) Ta-d-p(O1)	O1, F6
74	$W^{185, 187}$	C		23 h.(M14)			W-n-γ(M14, A1)	A1, M14
75	Re	E		55 m.(D9)			W-p-n(D9)	D9
	Re	E		14 d.(D9)			W-p-n(D9)	D9
	Re^{186}	B	β^-	90 h.(S16)	1.2(S16) cl. ch. K. U.		Re-n-γ(S16, K7) Re-n-2n(S16) W-p-n(D9)	S16, K7, D9
	Re^{188}	B	β^-	18 h.(P2)	2.5(S16) cl. ch. K. U.		Re-n-γ(P2, K7, S16)	S16, K7, P2
76	$Os^{191, 193}$	C	β^-	40 h.(K7)			Os-n-γ(K7)	K7
77	$Ir^{189, 194}$	C	β^-	1.5 m.(M15)			Ir-n-γ(M15)	M15
	$Ir^{189, 194}$	C	β^+	19 h.(M15, A1)	2.2(A2) spect.		Ir-n-γ(M15, A1, P2, J1) Au-d-n, p(?)(C18)	M15, A1, P2, C18, A2, J1
	$Ir^{192, 194}$	C	β^-	60 d.(M15, F6)			Ir-n-γ(M15, F6, J1)	M15, F6, J1

Radio-element		Class	Type of Radiation	Half-Life	Energy of Radiation (Mev)		Produced by	Observers
Z	A				Particles	γ-rays		
78	Pt^{197}	B	β^-	18 h.(M15)			Pt-n-γ(M15) Pt-d-p(C19)	M15, C19
	Pt^{197}	B	β^-	3.3 d.(M15)			Pt-n-γ(M15, P2)	M15, P2
	Pt^{199}	A	β^-	31 m.(M15)			Pt-n-γ(M15, A1, M14) Pt-d-p(C19)	M15, A1, C19, M14
79	Au^{198}	B	β^-	13 h.(M15)			Au-n-2n(M15)	M15
	Au^{196}	B	β^-	4–5 d.(M15)			Au-n-2n(M15)	M15
	Au^{198}	A	β^-, γ	2.7 d.(M15, A1)	0.8(M15, R2) abs. and cl. ch.	0.28, 0.44, 2.5(R2, S17) cl. ch. recoil	Au-n-γ(M15, A1, P2) Au-d-p(C18)	M15, A1, C18, R2, S17, P2
	Au^{199}	A	β^-	3.3 d.(M15)			Pt^{199} β^- decay (M15)	M15
	Au	C		17 m.(P2)			Pt-n-γ(?)(P2)	P2
80	Hg^{197}	B	K, ε^-, γ (R11, A4)	43 m.(H10, M15)	<0.4(M15) abs.	<0.25(M15) abs.	Hg-n-2n(M15, H10, P2)	M15, H10, P2, R11, A4
	$Hg^{203, 206}$	C		25 h.(M15)			Hg-n-γ(M15, A9)	M15, A9
81	Tl^{200}	F		4 m.(K3)			Au-α-n(?)(K3)	K3
	Tl^{200}	F		3.8 h.(K3)			Au-α-n(?)(K3)	K3
	$Tl^{204, 206}$	C	β^-	4 m.(P10, H10)			Tl-n-γ(P10, P2, H10)	P10, H10, P2
	$Tl^{204, 206}$	C	β^-	97 m.(P10, M16)			Tl-n-γ(P10, M16, P2)	P10, M16, P2
82	Pb^{203}	B		80 m.(D10)			Pb-n-2n(D10)	D10
	Pb^{209}	B	β^-	3.0 h.(T5)			Pb-d-p(T5)	T5
83	Bi^{210}	A	β^-	5 d.(L13)			Bi-d-p(L13)	L13
84	Po^{210}	A	α	136 d.(L13)			Bi^{210} β^- decay (L13) Bi-d-n(V4)	L13, V4
	Po	F	α	7.5 h.(C23)	6, 7.5(C23) abs.		Bi-α(32 Mev)	C23
90	UY^{231}	B	β^-	24.5 h.(N5)			Th-n-2n(N5)	N5
	Th^{233}	A	β^-	26 m.(M17)			Th-n-γ(M17)	M17
91	Pa^{233}	F	β^-	25 d.(M17)			Th^{233} β^- decay (?)(M17)	M17
92	U^{239}	B	β^-	23 m.(I1, S4)			U-n-γ(H18, H14, I1, S4, M19)	H18, H14, I1, M19, S4

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